Do banks influence stock crash risk? Evidence from banking deregulation*

Abstract: An extensive literature shows that managers' withholding of bad news, an agency problem in corporate governance, plausibly causes stock price crashes. This literature, however, has not examined whether and how lending banks influence borrowing firms' crash risk, despite banks' advantageous role in corporate governance via their monitoring and funding functions. We fill this void in this study. To mitigate endogeneity, we exploit the staggered reforms in U.S. state-level banking markets that gradually lift barriers for interstate branching. These deregulation events, which are exogenous to firms, represent historically important shocks to bank competition, and bank competition can fundamentally alter bank monitoring and funding behaviors. We find robust evidence that bank competition reduces firm crash risk, and the effect is stronger in scenarios in which bank monitoring and funding are likely to exert greater influences. Bank competition also mitigates abrupt divulgence of adverse information, suppresses earnings management, and improves reporting quality, which helps explain the decline in crash risk.

JEL Codes: G19; G21; G28; G34
Keywords: Interstate branching deregulation; Stock crash risk; Bad news hoarding

1. Introduction

Stock crash risk, manifested by the unusual firm-level stock price deep plunges, has been of keen interest to practitioners, academicians, and policy makers. Theorists generally agree that managerial opportunistic behaviors that conceal bad firm news constitute a major reason for firm-specific crash risk. According to the bad news hiding argument, negative information is stockpiled for a prolonged time until being divulged all at once at a tipping point, leading to a precipitous price drop and thus crash (Jin and Myers 2006; Bleck and Liu 2007; Hutton, Marcus, and Tehranian 2009; Kothari, Shu, and Wysocki 2009). Under this logic, crash risk in stock price of a firm hinges on the willingness and ability of its managers to withhold the disclosure of inferior message about the firm. Numerous studies have made continuous efforts, both theoretically and empirically, to identify a large number of factors that may influence managerial bad news hoarding behaviors and the consequent price crash risk. The areas explored are exceptionally vast, covering, among others, corporate disclosures (e.g., accrual management, accounting conservatism, financial reporting rule, format, readability, comparability, and opacity, and other information concealing mechanisms such as tax avoidance), managerial features (e.g., compensation structure, perks, manager ability, age, psychological biases like overconfidence), corporate governance (e.g., auditing, voting rights, internal control, institutional holding, analyst following, governmental supervision, political connection), market structure (e.g., liquidity, product market competition, short interest), and social norms (e.g., religion, social responsibility, mutual trust).[1] In this remarkably rich literature, however, there is a salient, and significant, negligence: creditors, in particular, banks. It is surprising that, after over a decade of intensive studies, we still have little

[1] Refer to Habib, Hasan, and Jiang (2018) for a recent summary of related studies, and also some fresh evidence from Bao, Fung, and Su (2018), Kim, Lu, and Yu (2019), Kim, Wang, and Zhang (2019), Li and Zhan (2019), and Zhang, Guan, and Kim (2019), and many others.

knowledge about whether and how banks influence stock crash risk, given the fact that banks are an especially important stakeholder that exerts critical impacts on firms' financing, investments, and operations. This knowledge gap motivates our study of the relation between banks and borrowing firms' crash risk, as conducted in this paper.

Our inquiry about the influence of banks on firm-level stock price crash risk is necessary and important because banks play a unique and critical role in corporate governance (Shleifer and Vishny 1997), and better corporate governance aims to solve the agency problems that are the root of opportunistic hiding of negative firm information (Jin and Myers 2006).[2] This role is peculiarly relevant to crash risk because banks, unlike other creditors from the public debt market, have an informational advantage in monitoring borrowing firms' behaviors and also the flexibility of adjusting funding decisions to the firms. In other words, banks influence borrowers' bad news accumulation and crash risk via monitoring and funding channels. To the extent that firms heavily rely on bank financing, these influences from banks can be significant.

However, empirically examining the impact of banks on stock crash risk faces substantial challenges because their relationship is plagued by severe endogeneity problems. The foremost obstacle is that the causal direction is difficult to determine. On the one hand, borrowing firms may condition their intended bad news hiding behaviors on the lending banks' strength of disciplines in monitoring and funding; On the other hand, banks may also base their decisions of lending and terms of monitoring (e.g., covenants) on the borrowers' governance status including opportunistic news concealing. Meanwhile, potential omitted variables may be simultaneously correlated with both bank behaviors and firm behaviors. For example, it is possible that a market-

[2] The bulk of research, especially empirical works, follows Jin and Myers (2006) who introduce the managerial bad news hiding theory in an agency theoretical framework. Hong and Stein (2003) suggest that with the lack of a mechanism to reveal bad news by pessimistic investors, crash risk builds up.

wide financial crisis makes bank loan terms especially tightened and at the same time makes it difficult for firms to disguise the worsened situation (or reduces the incentive for the managers to do so because the opportunistic cost is minimal during a recession). For these reasons, the inference from an association examination between, say, loan terms and stock crash risk tends to be limited.

In this paper, we overcome these challenges by identifying exogenous shocks from a natural experiment that are likely to change bank monitoring and funding practices, and examining whether and how firms' stock price crash risk also changes accordingly. Because these shocks affect banks *only*, and are largely independent of firm news disclosing practices, any change in firm behaviors can be attributed to changes in bank activities. The banking shocks in our natural experiment come from the interstate branching deregulation in the U.S. – the revolutionary reforms that lifted the restrictions to banks' geographic expansion across state borders and fundamentally changed the U.S. banking markets. When a state relaxes the constraints to out-of-state branching to a larger extent, it brings higher level of entry threat into the state's banking market, which substantially alters the competitive environment among banks. A significant literature has argued that bank competition fundamentally changes banks' monitoring & screening and credit providing (e.g., Cetorelli and Strahan 2006; Rice and Strahan 2010; Amore, Schneider, and Zaldokas 2013; Bushman, Hendricks, and Williams 2016; Bai, Carvalho, and Phillips 2018), both of which are closely related to borrowing firms' willingness and ability to manipulate information and hide bad news, and thus hold the potential to affect their stock price crash risk. Importantly, the bank deregulation process was uncorrelated with firms' demand for credit or corporate governance (Kroszner and Strahan 1999; Black and Strahan 2002; Kerr and Nanda 2009; Rice and Strahan 2010), providing an ideal laboratory for our investigation of the causal effect from lending banks to borrowing firms.

Given the novel research setting, however, the direction and amplitude of the potential influence of bank competition on borrowers' stock price crash risk remain an open empirical question. The literature is divided on how competition in the bank market influences bank monitoring and bank funding, and it is unclear, given the changes in monitoring and funding, how firm managers respond to these changes in their information hiding behaviors. For bank monitoring, intensified competition helps more efficient banks win out, and the improved overall efficiency in the banking market tends to bring about better loan monitoring and screening (Jayaratne and Strahan 1996, 1998; Demyanyk, Ostergaard, and Sorensen 2007; Bai et al. 2018). However, fiercer competition may also force banks to relax lending standards to compete for more loans, including the screening and monitoring efforts (Bushman et al. 2016), and distance can hinder the ability of a bank's headquarters to monitor its subsidiaries or branches in a newly entered state (Brickley, Linck, and Smith 2003; Berger, Miller, Peterson, Rajan, and Stein 2005), which in turn may adversely affect the monitoring of loans and managing of risk. In theory, it is possible that, on average, banks' monitoring function is improved and the difficulty of concealing bad news is heightened; It is also possible that a firm in a deregulated state has more options to borrow from out-of-state banks, which may provide a room for the firm to manipulate its information due to its greater bargaining power and before the remote lenders have a thorough comprehension of its business. Therefore, the net effect is uncertain. For bank funding, higher degree of contestability among credit providers in general is beneficial to borrowers, as reflected in increased credit availability and lowered funding cost (Jayaratne and Strahan 1998; Cetorelli and Strahan 2006; Demyanyk et al. 2007; Kerr and Nanda 2009; Favara and Imbs 2015). At the same time, with bank profit margins being squeezed by competition, banks' capacity of risk absorption is undermined, which may reduce liquidity creation from the banking system (Petersen and Rajan 1995; Jiang,

Levine, and Lin 2019). Even if a firm is facing more credit options and more benign loan terms, it is still unclear whether it opts to hide bad news because the benefit (it does not have to beautify the information to compete for better loans) and cost (revealing more bad news won't hurt corporate financing as much) of doing so are both reduced. Overall, theory suggests differing predictions for the effect of bank competition on bad news hoarding and crash risk.

To provide empirical inference for the ultimate effect of bank competition on stock crash risk, we construct tests using the adoption events of the Riegle-Neal Interstate Banking and Branching Efficiency Act (IBBEA) in different states of the U.S. as exogenous changes in bank competition that bring about plausible shocks to borrowers' managerial opportunistic information concealing behaviors. We find robust evidence that increases in bank competition significantly lower borrowers' stock crash risk, as manifested in the reduced likelihood of experiencing extreme price plunges and the decreased magnitude of conditional return skewness, both of which reflect the rare left-tail risk in stock returns (Bates 1991, 2000; Chen, Hong, and Stein 2001). Economically, after deregulation, borrowers in states that are completely open to interstate branching exhibit extreme price plunge likelihood 2.4% lower than in states with the most restrictions in out-of-state entry, a 14% decrease over the unconditional level of crash likelihood. Consistently, measures about stock return skewness also become significantly lower in more competitive banking markets. The evidence suggests that, with enhanced bank competition, the monitoring function of banks is improved and is also effective in constraining borrowers' bad news hiding behaviors, and/or the change in credit provision also helps curb firms' stock crash risk. Altogether, our findings point to a financial stability effect of bank deregulation and competition from the aspect of borrowing firms, at least for the firm-level crash risk.

We further show that the overall influence of bank competition on stock crash risk works through banks' economic connections with firms and comes from both their monitoring and funding functions. We find that among firms with higher degree of bank dependence, the bank competition effect is significantly larger, suggesting that banks exercise their influences on firms via the borrowing-and-lending operations: If firms have more reliance on bank finance, they exhibit stronger reactions to a more competitive banking market by curbing their opportunistic news hiding actions. Furthermore, we find that if a firm's information environment is more opaque, as reflected by high level of discretionary accruals, bank competition has a greater impact on the reduction of crash risk. Because monitoring plays an increasingly important role in informationally opaque firms, this evidence is consistent with the proposition of improved bank monitoring after bank deregulation. The literature also shows that bank deregulation substantially fosters innovations by providing more credits to innovative firms (Amore et al. 2013; Chava, Oettl, Subramanian, Krishnamurthy, and Subramanian 2013; Cornaggia, Mao, Tian, and Wolfe 2015), and thus the enhanced competition favors the funding to these borrowers. In line with this set of evidence, we find that more innovative firms, i.e., those with higher levels of R&D investments, have a significantly larger reduction in crash risk after bank deregulation. This finding echoes Amore et al. 2013, Chava et al. 2013, and Cornaggia et al. 2015, and further implies that increased credit support from bank competition attaches an opportunity cost that is relatively larger than potential benefit for managerial hoarding of negative information, making it no longer a worthwhile endeavor. We thus document the evidence for the influence of bank competition on crash risk via bank funding.

To complete the logic chain from bank competition to stock crash risk, we make additional effort to confirm the role of bad news hiding which, in theory, is a critical link between bank

behaviors (monitoring and funding) and firm stock crash risk. We do so by directly examining the impact of bank competition on ex post incidence of abrupt divulgence of extremely unfavorable information and firms' accounting manipulation behaviors. We find that reduced restrictive barriers in the banking market lead to a significant smaller likelihood of a sudden release of very bad news that could trigger a crash. We further document that increased banking market contestability causes less information-hiding accounting practices such as earnings management, and the occurrence of accounting restatement is also reduced subsequent to enhanced bank competition. The evidence suggests less frequent divulging of extremely negative information (i.e., accumulated bad news in the past) after a tipping point, and more transparent and truthful financial reporting practices for firms in states with more competitive banking market. This implication not only is consistent with the generally accepted idea that hiding bad news by managers is a key driver of stock crash risk, but also substantiates the economic logic that bank competition could influence firm crash risk via affecting accounting treatment of information and more generally corporate governance.

By connecting bank competition with stock crash risk, our study contributes to these two large literatures. Our contributions are not merely the identifications of yet another determinant of stock crash risk and an additional consequence of bank deregulation, although these are certainly novel findings. In our opinion, establishing the links between bank market, managerial information concealing, and firms' price crash is more important. These links are embedded in a broader network involving banking, accounting, and equity market. For crash risk research, our study opens a new window to the credit market, especially the banking industry, which is one of the most influential sectors for firms' information disclosure and risk control due to its critical monitoring

and funding roles.[3] This new aspect of examination, given our initial evidence documented in this paper, could potentially entail a series of issues from the bank market that may affect stock crash risk such as the concrete bank monitoring schemes (e.g., covenant violation) and funding decisions (e.g., loan re-contracting). These issues are to be further explored in future researches. As such, our work makes a significant complement to existing literature. Also, we emphasize the effect of market structure, a largely underexplored area in crash risk studies. This consideration is potentially insightful because most existing studies focus on the direct stakes held by stakeholders (e.g., investors), rather than the interactions among the stakeholders. Two recent papers from Chang, Chen, and Zolotoy (2017), who examine the liquidity-related trading microstructure of the stock market, and Li and Zhan (2019), who investigate the product market competition, are the only exceptions (to our best knowledge). We add new insights to this direction of research by examining the market structure from the credit market. Unlike Chang et al.'s (2017) and Li and Zhan's (2019) works in which the market settings are firms' stock and product trading platforms, our market structure subject is not directly related to the firms themselves, and for this reason, our evidence speaks to the transferring mechanism from outside stakeholders to the inside firm managers.

For bank deregulation and bank competition research, our study helps answer the central questions in finance and economics about whether the bank system can stabilize the economic system, or more generally, whether financial market affects economic development in which risk is a critical concern. The banking literature has devoted extensive effort to examining these issues, but competition-related financial stability studies mostly take the perspective from the banking

[3] Liu, Ng, Tang, and Zhong (2018) suggest that investors reveal their pessimistic opinions through trading credit default swaps (CDS), which helps reduce crash risk. Their study, although explores the debt-related CDS market, does not speak to the banking sector and how creditors may influence managerial bad news hiding behaviors.

sector itself (Akins, Li, Ng, and Rusticus 2016; Bushman et al. 2016; Goetz, Laeven, and Levine 2016), i.e., how bank competition affects bank risks, rather than borrowing firms' risks. The perspective in our study supplements this literature because we focus on firms' risks. Our empirical examination of borrowers is informative for the major bank competition-stability theory pioneered by Boyd and De Nicolo (2005) in which the borrowers' risks are emphasized, and we believe our work provides the first borrower-based evidence that is relevant to this highly influential theoretical hypothesis, although not a direct test. Our specific focus on crash risk is also of particular relevance to financial stability. Moreover, our study introduces the considerations from corporate governance and corporate disclosure, which have not been explored in existing bank competition studies. These considerations are important because our evidence suggests that banks may influence firms' risks not only through changing the fundamental risk in corporate investment (as modeled in Boyd and De Nicolo (2005)), but also through affecting the information and governance environment in an agency framework. A refined theory incorporating these additional features and the crash risk reducing effect of bank deregulation may better describe how a competitive bank market further helps stabilize the equity market and the whole economy.[4]

The remaining of this article is organized as follows: Section 2 reviews related literatures and develops the conceptual framework; Section 3 introduces measurement and research models; Section 4 reports baseline results; Section 5 provides evidence relevant to bank monitoring and funding roles; Section 6 specifically examines bank competition's effect on firm information disclosure; Section 7 concludes.

2. Related literature and conceptual development

[4] Our evidence about the relations between bank deregulation and *firms*' bad news releasing practice and earnings management also supplements Jiang, Levine, and Lin (2016), Burks, Cuny, Gerakos, and Granja (2018), Dou, Ryan, and Zou (2018), and Tomy (2019). These studies examine how bank competition affects *banks*' opaqueness, voluntary disclosure, accrual management, and discretionary reporting.

Crash risk research is surrounded by the key theoretical argument that the agency problem in corporate governance allows the possible managerial strategy to hide bad news for an extended period. The banking literature proposes an important delegated role of banks to monitor firms via their funding practice, and bank competition can largely alter bank monitoring and funding. The key link between bank competition and firms' crash risk thus hinges on the premises that (i) bank competition changes bank monitoring and funding, and (ii) the change in monitoring and funding functions of banks engenders the change in bad news hiding behaviors in firms.

2.1. Literature review

2.1.1. Relevant research of stock price crash risk

There has been a proliferation of empirical research on the agency conflict-based crash risk theory developed by Jin and Myers (2006), in which inside managers have information that outside stakeholders do not have, and the conflict of interest between insiders and outsiders, when combined with opacity, motivates and enables managers to hoard bad news for their own benefit (Kothari et al. 2009). The hidden unfavorable private information piles up over time to a certain threshold beyond which the controlling insiders exercise an abandonment option (because the cost of absorbing further bad news exceeds the associated benefit) to release the accumulated bad news all at once, causing an abrupt downside crash of stock price. The literature has produced exceptionally rich evidence with regard to the determinants of stock crash risk. This line of research builds on the notion that the determining factors work through influencing insiders' willingness and ability to withhold bad news.[5]

Nevertheless, although the agency framework of crash risk theory critically depends on the connections between a firm and its investors, including both equity holders and creditors, only a

[5] One notable exception is Kim, Wang, and Zhang (2016) who propose that CEO overconfidence leads to larger stock crash risk due to CEO's unknowingly ignorance of private negative news.

few papers directly examine the role of firm investors in affecting crash risk. The only studies that we are aware of are An and Zhang (2013), Callen and Fang (2013), and Kim, Li, Luo, and Wang (2019) who document that institutional equity ownership or foreign investor helps reduce stock price crash risk.[6] These studies highlight the monitoring function of sophisticated institutions, consistent with other external monitoring factors such as analysts (Kim, Lu, and Yu 2019), auditors (Callen and Fang 2017), and regulators/government (Kubick and Lockhart 2016; Luo, Gong, Lin, and Fang 2016). In this line of research, the role of creditors, especially bank lenders, is an obvious void, despite that bank monitoring is a traditional and important mechanism to supervise firm behaviors. Moreover, banks' funding activities further influence managers of borrowing firms, which is different from equity holders whose investing actions mainly take place in the secondary market and thus cannot directly affect corporate financing. Relative to bank market, the equity market is more likely to host transient investors whose decisions could place excessive emphasis on short-term performance and thus do not help solve the agency problem of bad news withholding (Chang et al. 2017).

A recent study by Li and Zhan (2019) examines the product market competition and finds that intensified competition aggravates bad news hoarding and crash risk. For crash risk determinant studies, market competition, and more generally, market structure, is a much underexplored area. Competition among competing firms, as shown in Li and Zhan (2019), could influence opportunistic behaviors; Competitions among other stakeholders, in a same vein, could also affect managerial behaviors through altering the influencing role of the stakeholders. In our study, we take the perspective of competition among lending banks to examine how the bank

[6] Chen et al. (2001), Hong and Stein (2003), and Callen and Fang (2015) also take the perspective of equity investors by investigating how different opinions, especially those from short sellers, affect crash risk. These studies, however, do not consider potential agency problem and the associated managerial behavior.

monitoring and funding functions as changed by the competition influence borrowing firms' bad news hoarding and crash risk.

2.1.2. Relevant research of banking and bank competition

Banks as significant creditors are generally large and active investors because they have substantial investments in the firm (Shleifer and Vishny 1997). In protecting their investments and materialize the returns, banks can exercise the role of interfering in corporate governance because of their advantage in accessing borrowers' inside information, which is unique to banks and unavailable to arm's-length investors in the equity and public debt markets (Fama 1985; Rajan 1992; Denis and Mihov 2003; Bharath, Sunder, and Sunder 2008). Modern finance theory suggests critical functions of banks in screening, monitoring, and liquidity providing (Diamond and Dybvig 1983; Diamond 1984; Ramakrishnan and Thakor 1984; Allen 1990; Winton 1995; Kashyap, Rajan, and Stein 2002). These powers have the penitential to mitigate agency conflict, including the managerial concealing of expropriation activities from outsiders via withholding bad news that eventually leads to crash risk.

Change in banking markets is an important source of banks' change in screening, monitoring, and funding (Jayaratne and Strahan 1996). One of the most fundamental changes in the U.S. banking markets is the branching deregulation which greatly enhances the competition among banks. Numerous studies have used the branch banking reform as an experimental setting to examine the influences of financial markets on the quality of bank intermediation. A tradition view, as expressed by Jayaratne and Strahan (1996) and Bai et al. (2018), is that a less restricted bank market for corporate control induces a more potent selection mechanism and a stronger incentive for performance that tend to improve the overall bank efficiency and lower the costs of screening and monitoring risky borrowers. Bushman et al. (2016), however, argue that greater

competition can pressure banks to relax lending standards, including lowered underwriting standards, less sensitivity of loan spread to credit quality, and less number of covenants. Hauswald and Marquez (2006) propose that, as competition increases, banks' proprietary information acquisition may fall, leading to less efficient lending. In addition, Brickley et al. (2003) and Berger et al. (2005) suggest that a bank's ability to monitor its branches and subsidiaries could be weakened by the increased distances (and potential complexity (Winton 1999)) that are likely to be induced by interstate branching, which may hinder the monitoring of borrowers' risks. These opinions suggest a less stringent loan selection process that may undermine the efficiency of bank screening and monitoring.

With regard to the funding provision function, a large number of studies document that bank competition generally improves credit availability and lowers credit cost (Jayaratne and Strahan 1998; Cetorelli and Strahan 2006; Demyanyk et al. 2007; Kerr and Nanda 2009; Favara and Imbs 2015). The basic rationale is that competition spurs innovation and boosts market efficiency by forcing price closer to marginal cost. This logic is confirmed by the findings of Amore et al. (2013), Chava et al. (2013), and Cornaggia et al. (2015) that innovations increase along with the staggered deregulation of banking activities. In contrast, Petersen and Rajan (1995) and Jiang et al. (2019) contend that competition among banks squeezes profit margins and depletes buffers against losses, which is harmful to relationship lending and liquidity creation, making credit-constrained firms less likely to be funded by bank creditors. To the extent that both screening & monitoring and funding channels are related with stock price crash risk, our study adds more insights to these disputes about the consequences of bank deregulation.

In a more general setting, our study relates to the research about bank competition and financial stability, a fundamental, but unsolved, issue in economic research. Prior literature mainly

focuses on competition's impact on banks' own risk-taking behaviors, and offers competing predictions and evidence, both theoretically and empirically. A widely-held belief is banks with concentrated market power may abstain from too much risk exposure which could jeopardize their charter value, and bank competition reduces the franchise value and creates incentives for excessive risk-taking (Keeley 1990; Allen and Gale 2000; Hellmann, Murdock, and Stiglitz 2000; Repullo 2004). This theory obtains supports from Demsetz, Saidenberg, and Strahan (1996), Gan (2004), and Bushman et al. (2016). In contrast, Boyd and Nicolo (2005) posit that the lack of competition may cause banks to charge higher interest rates, inducing firms to undertake riskier projects under a moral hazard motive which in turn increases the risk of banks. Akins et al. (2016), by checking banks' engagement in risky activities, find evidence consistent with this hypothesis. Different from these existing studies, our empirical work takes the perspective of borrowing firms, *not* lending banks. Viewed differently, our study can be considered as a direct check of *firm* risk in the Boyd-Nicolo logic, which differs from Akins et al. (2016) who still examine *bank* risk. Moreover, when we examine firm risk engendered by bank competition, the nature of the risk is induced by managerial opportunism, i.e., an agency problem in which moral hazard arises. As such, our study provides a novel and concrete channel through which the borrowers' risks interact with the lenders', as suggested by Boyd and Nicolo (2005), and expands our understanding of the social desirability and economic role of bank competition.

Another novel feature of our study is that, by connecting crash risk with potential bad news hiding activities, we provide inference for bank competition's impact on information quality. Existing studies in this area focus their attention exclusively on banks' information opacity, rather than the borrowers'. For example, Jiang et al. (2016) show that intensified competition reduces banks' abnormal accruals and restatement frequency, and Burks et al. (2018) find that increase in

competition is associated with increase in voluntary disclosure of banks. More relevantly, Bushman, Wang, and Williams (2017) offer evidence that intense competition reduces agency costs (including the concealing of managerial expropriation activities) of banks in the form of loan loss provision (LLP) smoothing. These findings point to an improvement in bank information quality after deregulation.[7] Supplementing these studies, we provide evidence that bank competition could also improve borrowing firms' information quality by curbing managerial concealing of negative firm information.

2.2. Conceptual development: Bank competition could impact firms' stock crash risk

As discussed above, the literature generally agrees that bank competition holds the potential to alter the creditor monitoring and credit supplying conditions, which could influence the motive and ability of managers to conceal negative news – the critical driving factor of stock price crash risk in the agency theory framework. However, prior studies disagree on how competition among banks affects their monitoring and funding behaviors. If the screening & monitoring improving effect dominates, intensified competition spurs more stringent bank supervision and control that could largely shrink the room for managers' information manipulation to conceal bad news in the borrowing firms; On the other hand, if heightened pressure from rivals forces banks to loosen borrower selection and private information acquiring processes to compete for loan customers, or the complexity and hierarchy of a banking conglomerate hinder efficient risk management, the bank screening & monitoring function could be weakened, granting greater leeway to firm managers to maneuver information disclosure. In a similar manner, if credits generally become cheaper and easier to obtain after barriers for bank competition are lifted, the

[7] Two relevant studies from Dou et al. (2018) and Tomy (2019) document that incumbent banks manipulate discretionary LLP to deter entry. However, they have opposite conclusions about whether increasing or decreasing LLP hinders the entry of potential rivals.

strength of bank disciplining is likely to be mitigated; If, on the contrary, the liquidity intermediation function of banks is hampered by bank competition, borrowing firms tend to treat lending banks' concerns more seriously and accept stricter constraining terms. These bank funding factors could translate into managerial behaviors, but with contradictory effects.

In the context of bank branching deregulation, bank competition manifests in the entry of out-of-state rivals into a local state. Relative to the pre-deregulation era, local firms face more potential lenders from other states after the deregulation. This brings in additional complexity that, on top of the undetermined effects from bank monitoring and funding, could further muddle bank deregulation's impact on managerial treatment of negative firm news. On the one hand, geographical distance may cause out-of-state bank creditors to be more reliant on firm disclosures to collect information to monitor and control the borrowers (Chen and Vashishtha 2017), making it harder for firms to hide bad news; On the other hand, upon the entry of out-of-state banks, local firms may have more leeway for information manipulation because the newly arrived lenders do not know them well enough (at least at the initiation of the deregulation) and they tend to communicate with borrowers in more impersonal ways due to the paucity of soft information (Petersen and Rajan 2002). The expanded set of banks from which firms can borrow also grant borrowers' enhanced bargaining power (Chava et al. 2013), which tends to alleviate their motives for a thorough disclosure of negative news. Moreover, the change of credit supply after deregulation does not affect managers' withholding of bad news in an unambiguous way, because a, say, credit expansion that lowers the funding threshold and loosens the financing constraints may not automatically lead to a definite decrease or increase in managerial information concealing behaviors. After all, managers hide bad news for their own welfare, normally via a glamorized performance. A more lenient funding environment makes their lives easier by reducing cost of

capital and facilitating more profitable corporate investments. It is therefore not imperative to artificially inflate the performance by hiding unfavorable message. In other words, the benefit of beautifying firm information, especially for the purpose of applying for better loan terms, becomes minimal. At the same time, however, the lax credit background may simultaneously reduce the cost of hiding bad news as well, because, when facing more potential lenders competing for loans, a borrower's funding conditions won't be hurt that much even after its information concealing activities are detected. Similar arguments can be made in the scenario of credit shrinkage.

In summary, bank competition, as induced by interstate branching deregulation, holds the potential to affect firms' stock price crash risk. However, the eventual effect hinges on how the deregulation changes banks' monitoring and funding functions, and how firms react to these changes. Overall, whether and how banks influence borrowers' stock crash risk is ultimately an open empirical question.

3. Research design

We trace the firm-level effect of a major U.S. banking market deregulation process that captures focused changes in the degree of state-level bank competition, on the borrowing firms' crash risk manifested in the distribution tails of their stock returns. We adopt rather standard approaches that have been widely used in the literature to measure bank competition and crash risk, and also to exam the former's impact on the latter.

3.1. Variable measurement

3.2.1. Measuring bank competition

To clearly identify the causal influence from banks to borrowers' stock crash risk, we resort to the exogenous shocks to bank competition, which, as suggested in numerous studies, can affect managerial bad news concealing behaviors that cause price crashes. In our setting, these exogenous

shocks are characterized by the policy changes fostering competition in U.S. banking that alters the openness to out-of-state branching. Although banking deregulation of the U.S. financial sector started from 1970s, banks were generally not permitted to open branches across state lines until 1994 with the passage of the IBBEA. While the IBBEA cleared the federal-level legal impediment for nationwide branching, it granted state legislatures the leeway to determine the extent of adoption. The varying extent of adoption is reflected in the conditions on the entry of out-of-state banks imposed by different states, and these conditions pertain to various barriers permitted by the IBBEA. Specifically, states are free to erect up to four restrictions on out-of-state entry: (i) For interstate bank mergers, states are allowed to impose a minimum age requirement, for a maximum of five years, for target institutions; (ii) A bank cannot open a new interstate branch under the IBBEA in states that do not expressly "opt-in" to this provision (iii) States can forbid an interstate merger transaction with any financial institution that holds deposits exceeding a certain threshold (e.g., 30% of the state aggregation); iv) Unless explicitly allowed by the states, any interstate acquisition of only a branch (or number of branches) of a bank, rather than the entire bank, is prohibited. All these restrictive terms are directly relevant to the openness of a local market, and can substantially change the competitive environment of banks.

A unique feature of the IBBEA-induced interstate branching deregulation is that individual states can choose to impost none, some, or all of the out-of-state bank entry barriers described above, which effectively reflects the differing levels of bank competition and constitutes an advantage over the dichotomous indicators of the pre- and post-statuses of the adoption of a certain regulation. Moreover, many states have chosen to gradually remove the barriers on interstate branching, generating an especially rich series of event data corresponding to the staggered shocks to bank competition that affect different states (and the banks/firms therein) at different times and

to different extents. Rice and Strahan (2010) provide a detailed timeline for each deregulation event date, the number of barriers removed, and the remaining constrictions for all states (as well as the District of Columbia (D.C.)). Various researches, drawing on the political economy of these legislative reforms, have shown that the passages of deregulation policies are not characterized by clear patterns or endogenous dependence on product markets to which the borrowing firms belong (Black and Strahan 2002; Kerr and Nanda 2009; Amore et al. 2013). This institutional background provides an ideal setting to extract exogenous changes in bank competition that are driven by legislators in different states and less likely to coincide with other potential, omitted concurrent statewide affairs unrelated to branching deregulation (Leuz and Wysocki 2016).

We exploit this exogenous setting to construct our measure for bank competition. Following Rice and Strahan (2010) and Bushman et al. (2016), we define an IBBEA deregulation index, denoted by *RegIndex*, for each state in each year, based on the number of existent interstate branching barriers among (i) requiring a minimum age of at least three years on target institutions, (ii) forbidding de novo interstate branching, (iii) applying a deposit cap less than 30%, and iv) prohibiting individual branch acquisitions. The index has possible discrete values ranging from zero to four, and takes a lower value after the removal of one or more restrictive barriers upon the passage of each deregulation legislation in a particular state, suggesting a more competitive environment among banks in the local banking market. Due to its novel institutional feature, numerous studies, e.g., Dick (2006), Zarutskie (2006), Cornaggia et al. (2015), Bushman et al. (2016), Burks et al. (2018), and Dou et al. (2018), have adopted the same measure to identify the effect of competition on banking markets.

3.2.2. Measuring stock crash risk

We follow prior research (e.g., Chen et al. 2001; Kim, Li, and Zhang 2011a, 2011b) to estimate price crash risk by exploring the stock return characteristics, featuring two distributional properties: (i) The stock price crashes are firm-specific, reflecting firm-level managerial news concealing behaviors rather than the market-wide information shocks; (ii) The crashes should be rare but extremely impactful events, that is, they manifest in the stock return distribution tails, in particular, the left tail.

Specifically, to measure stock crash risk, we first filter out the market impact from the weekly return series for the stock of each firm, as shown below:

$$R_{j,\tau} = \alpha_j + \beta_{j1} RM_{\tau-2} + \beta_{j2} RM_{\tau-1} + \beta_{j3} RM_{\tau} + \beta_{j4} RM_{\tau+1} + \beta_{j5} RM_{\tau+2} + \varepsilon_{j,\tau} \quad (1),$$

where $R_{j,\tau}$ is the holding period return of week τ for a particular stock j, and RM_{τ} is the corresponding market return. $RM_{\tau-2}$, $RM_{\tau-1}$, $RM_{\tau+1}$, and $RM_{\tau+2}$ represent the lead and lag market returns by one or two weeks. Utilizing weekly frequency and adopting extra lead and lag terms of market returns are to minimize microstructure noise, especially potential biases from nonsynchronous trading. Eq. (1) is estimated each year for each stock, and the firm-specific returns are embedded in the residual weekly returns $\varepsilon_{j,\tau}$. We adopt its logarithmic form $W_{j,\tau} = ln(1 + \varepsilon_{j,\tau})$ and explore its distributional characteristics to estimate our stock crash risk measures.

Our first crash risk measure $CRASH_{j,t}$ is the indicator of the occurrence of crash weeks in which the firm-specific weekly returns fall at least 3.2 standard deviations below the annual mean, corresponding to a 0.1% probability under normal distribution, i.e., a rare once-in-1000 left-tail event. $CRASH_{j,t}$ is coded one if we can identify one or more crash weeks in a given year t for a given stock j, and zero otherwise.

Our second and third crash risk measures capture the high-moment property of the idiosyncratic stock returns, which utilize more distributional information and also reflect unusually

large price plunges. Specifically, as the second measure, for each stock *j* in each year *t*, we compute a negative conditional skewness measure $NCSKEW_{j,t}$ (representing negative coefficient of skewness) as shown below:

$$NCSKEW_{j,t} = -\left[n(n-1)^{3/2}\sum W_{j,\tau}^2\right] / \left[(n-1)(n-2)(\sum W_{j,\tau}^2)^{3/2}\right] \quad (2),$$

where *n* refers to the number of weekly returns in each estimation year. $NCSKEW_{j,t}$ essentially is the third moment of the distribution of firm-specific returns $W_{j,\tau}$ scaled by its standard deviation raised to the third power, multiplied by -1 in order to make higher value indicate larger degree of stock price crash.

The third crash risk measure $DUVOL_{j,t}$, which also reflects the skewed nature of stock returns, is estimated as follows:

$$DUVOL_{j,t} = \ln\left\{(n_u - 1)\sum_{down} W_{j,\tau}^2 / \left[(n_d - 1)\sum_{up} W_{j,\tau}^2\right]\right\} \quad (3).$$

In the above, n_u and n_d represent, respectively, the numbers of weeks with idiosyncratic returns above (i.e., up weeks) and below (i.e., down weeks) the mean in each one-year estimation window. $DUVOL_{j,t}$, estimated for stock *j* in year *t*, is the logarithm of the ratio of the standard deviation on the down weeks to the standard deviation on the up weeks. Since this measure does not involve third moment, it is less likely to be driven by outlier observations but still effectively detects skewed distribution, with higher value corresponding to a more left skewness.

3.2. Empirical model

We assess how bank competition affects borrower's stock crash risk in the context of the IBBEA adoption process across various states and along the time line, as in the following baseline model:

$$Crash\ Risk_{j,t} = \gamma_0 + \gamma_1 RegIndex_{j,t} + \gamma_2 ROA_{j,t} + \gamma_3 SIZE_{j,t-1} + \gamma_4 LEV_{j,t-1} + \gamma_5 MB_{j,t-1} + \gamma_6 DTURN_{j,t-1} + \gamma_7 SD\_RET_{j,t-1} + \gamma_8 MEAN\_RET_{j,t-1}$$

$$+Firm\ Fixed\ Effects + Year\ Fixed\ Effects + Residual \quad (4).$$

In the model, the dependent variable is one of the ex post crash risk measures $CRASH_{j,t}$, $NCSKEW_{j,t}$, and $DOVUL_{j,t}$. We match these crash measures of each firm j with the state-level IBBEA deregulation index as of year t, i.e., $RegIndex_{j,t}$, according to the locating state for the headquarters of the firm. As shown by Bharath, Dahiya, Saunders, and Srinivasan (2011), Dass and Massa (2011), and Amore et al. (2013), firms should be primarily affected by the branching deregulation in the states of their headquarters because of the easier information gathering and processing and the stronger propensity to borrow from local lenders. As such, our empirical investigation is at the firm level, which is different from most existing studies employing the IBBEA deregulation that conduct analyses at the state level. Amore et al. (2013) contend that firm-level analysis is advantageous in its ability to control for unobserved time-invariant firm effects, and also to examine heterogeneous responses to deregulation within a given state. To facilitate such empirical examination, we add firm fixed effects into our model to mitigate potential omitted factor biases. We also control for year fixed effects to capture time-varying factors across different deregulation stages in different states. To the extent that the firm indicators differentiate firms in deregulating states from those in other states, and the year indicators mark the pre- and post-periods for each deregulation event, our model essentially compares the cross-event crash risk change in the state that experiences branching barrier-lifting event with the corresponding change around the event time in states without deregulation movements, thus highlights the impact on firm crash risk specifically from policy shocks.

To further factor out the influences from time-varying firm characteristics, we follow Hutton et al. (2009) and Kim et al. (2011a, 2011b) to control for profitability measured by return on assets $ROA_{j,t}$, natural logarithm of firm size $SIZE_{j,t-1}$, leverage ratio $LEV_{j,t-1}$, and market-to-book

ratio $MB_{j,t-1}$. To be consistent with existing literature, we lag these variables by one year, except for the ROA measure which is estimated for the same year as crash risk.[8] Other control variables relate to stock market attributes, including investor heterogeneity, past return performance, and past return volatility, denoted by $DTURN_{j,t-1}$, $MEAN\_RET_{j,t-1}$, and $SD\_RET_{j,t-1}$, respectively. These factors predict stock crashes as shown by Chen et al. (2001). We estimate *DTURN* by the annual change in average monthly share turnover; *MEAN_RET* and *SD_RET* are proxied by the mean and standard deviation of weekly firm-specific stock returns, respectively. The Appendix provides definition details of these variables.

4. Main empirical results

4.1. Data and summary statistics

Our sample includes all non-financial public firms with common stocks listed on U.S. equity markets. We require these firms to be headquartered in one of the states (and the D.C.) in the U.S., and identify the locating states of their headquarters according to 10-K filings on the SEC's EDGAR (as augmented by the Notre Dame Software Repository for Accounting and Finance) in order to differentiate in-state (or local) firms from those in other states. Since the filings through EDGAR in 1994 and 1995 were associated with various phase-in periods for different types, we select the sample period from 1996 to 2016 to ensure accurate and sufficient identifications.[9] We obtain the timing of each state-level IBBEA deregulation event and the *RegIndex* values before and after each event from Rice and Strahan (2010), and match the values to the local firms. To estimate weekly return-based crash risk measures (and the equity market-related control variables), we obtain stock return data from CRSP and require a minimum of 30

[8] Prior studies (e.g., Kim et al. 2011a, 2011b) find that a firm's profitability performance exhibits significant association with its stock crash risk in the same period.

[9] Refer to https://www.sec.gov/edgar/searchedgar/accessing-edgar-data.htm for more EDGAR filing details. Our results remain qualitatively unchanged if we include the 1994-1995 data.

weeks with non-missing return observations for each 12-month estimation period. Accounting data, which are mainly used to estimate control, sample partitioning, and channel variables (to be explained later), are from COMPUSTAT. We winsorize all continuous variables at the 1st and 99th percentiles, and our final sample has 57,062 firm-year observations. Table 1 reports the distribution by year, which shows that the observation numbers do not have a dramatic variation and an obvious time trend, suggesting a roughly balanced panel data structure.

In Table 2, we report full-sample statistical summary of the main testing variables in the baseline model. The crash risk dependent variables *CRASH*, *NCSKEW*, and *DUVOL* have mean values of 0.170, 0.031, and -0.046, respectively, which are quite close to those reported in existing U.S.-focused crash risk studies with similar sample period, such as Kim, Wang, and Zhang (2019). The mean *CRASH* indicates that 17% sample firms experience at least one crash event during the sample period, reflecting an unconditional crash likelihood. All the crash risk measures have standard deviations substantially larger than their corresponding means, suggesting a large variation in crash risk levels that facilitates empirical inference. The key independent variable *RegIndex* has an average value of 2.230, a standard deviation of 1.374, and an interquartile range of 2.

4.2. Main results

4.2.1. Baseline result

Column 1 of Table 3 reports the estimation result for the baseline model in Eq. (4) using *CRASH* as the dependent variable. Following Kim, Shroff, Vyas, and Wittenberg-Moerman (2018), we employ a linear probability model for the estimation to avoid potential biases from nonlinear models with fixed effects (Greene 2004).[10] The key independent variable, *RegIndex*, has a positive

[10] Our results are robust to using a nonlinear model such as the Logit regression method.

coefficient of 0.006 that is statistically significant at the 5% level (*t*-value = 2.14). This evidence suggests that when competition among banks becomes more intensified, as reflected in the removal of entry barriers for out-of-state rivals (i.e., a reduction of the value of *RegIndex*), the likelihood of the incidence of borrowers' sharp stock crash tends to be significantly lower. For one standard deviation (1.374 in Table 2) decrease in the number of interstate branching restrictions, the likelihood of the occurrence of stock return plunges is reduced by 0.006×1.374 = 0.82%, which is 4.85% of the average level of unconditional crash likelihood (0.170 in Table 2); If *RegIndex* is reduced from the maximum possible value of four to the minimum possible value of zero, then the probability of crash exhibits a substantial drop of 0.006×4 = 2.40%. This implies that, economically, firms in states that are completely open to interstate branching have the average probability of stock price crash 2.40% lower than those in states with the most restrictions on interstate branching, representing a 14% decrease over the unconditional likelihood level. Therefore, the influence of bank competition on stock crash risk is not only statistically but also economically significant.

Column 2 reports the estimation result with the continuous variable *NCSKEW* as the dependent variable. The key coefficient on *RegIndex*, i.e., γ_1 in Eq. (4), is positive and statistically significant (*t*-value = 2.33). Its value of 0.017 suggests that the high-moment crash risk measure *NCSKEW* is 0.068 lower in firms headquartered in states without interstate branching barriers (*RegIndex* = 0) than in firms located in states with the most restrictive regulations for out-of-state bank entry (*RegIndex* = 4). For one standard deviation decrease in *RegIndex*, the drop in *NCSKEW* is 0.023 (= 0.017×1.374). As a comparison, one standard deviation change in *MB*, one of the strongest crash determinants documented in prior literature (e.g., Chen et al. 2001), causes a

NCSKEW change of 0.012 (= 0.003×4.216). This perspective suggests that bank competition also has economically meaningful impact on the negative coefficient of skewness.

Result regarding the other crash risk measure that is also related to skewed return distribution, *DUVOL*, as reported in column 3 of Table 3, reveals a similar pattern. The bank competition measure *RegIndex* has a positive coefficient of 0.007 with a *t*-value of 2.26, pointing to a less branching restriction-lower crash risk relation. Like *NCSKEW*, one standard deviation decrease in *RegIndex* leads to a 0.010 (= 0.007×1.374) drop of in *DUVOL*, which is larger in magnitude than the impact on the same measure from one standard deviation decrease in *MB* (0.001×4.216 = 0.004). Together with the evidence from columns 1 and 2, results in Table 3 deliver a clear message that bank branching deregulation, which tends to foster bank competition, induces a large decrease in the stock crash risk among borrowing firms.

Results about the control variables further clarify that the bank competition effect on crash risk is in addition to other traditionally accepted crash risk determinants from both firm fundamental and trading characteristics. Consistent with prior findings in numerous studies, we find that larger (bigger *SIZE*), growth (larger *MB*) firms with higher leverage (*LEV*) tend to be associated with higher degrees of stock crash risk, because the coefficients on *SIZE*, *MB*, and *LEV* are significantly positive in one or more model specifications with *CRASH*, *NCSKEW*, and *DUVOL* as the dependent variables. Firm profitability helps reduce crash risk, as shown by the significantly negative coefficients on *ROA* in all three columns. *SD_RET* appears to drive down stock crash likelihood measured by *CRASH*; Its negative coefficient implies that if a stock has maintained a lower level of volatility in the previous year, it is more likely to crash in the coming year. The firm fixed effects and year fixed effects further capture unobserved firm traits and time trend. With all these effects controlled, our main variable of interest, *RegIndex*, still shows

significant relations with all of our crash risk measures, highlighting the unique role played by banks in influencing stock crashes, as least in the context of bank branching deregulation.

4.2.2. Robustness

We conduct a couple of robustness checks for our baseline results. We ensure that the impact of *RegIndex* on crash risk is indeed caused by the deregulation reforms, in two ways. Frist, we adopt a multi-period dynamic approach that is similar to Kerr and Nanda (2009) and Amore et al. (2013) to examine whether there is any pre-exiting trend in crash risk prior to the changes of the interstate branching laws, in the following model:

$$Crash\ Risk_{j,t} = \delta_0 + \delta_1 Pre2 + \delta_2 Pre1 + \delta_3 Year0 + \delta_4 Post1 + \delta_5 Post2^{+} + CONTROLS + Firm\ Fixed\ Effects + Year\ Fixed\ Effects + Residual \quad (5).$$

To design the model, we restrict our sample to a seven-year window surrounding state deregulation years, i.e., three years before and three years after. We denote the reregulation year by an indicator variable *Year0*.[11] In the pre-deregulation era, we consider one year before the deregulation event as indicated by *Pre1*, two years before the event *Pre2*, and three years before the event *Pre3*. In a similar manner, in the post-reregulation era, we separate out one year *Post1* and two years and more *Post2*$^{+}$ post-deregulation. *Pre3* does not show up in the above equation because we treat it as the reference year. With firm and year fixed effects (as well as all other firm and trading characteristic variables, denoted collectively by *CONTROLS*, in the baseline model) controlled, this approach is a rather standard difference-in-differences (DiD) analysis in which we compare the crash risk levels of firms in a deregulated state with those in other states. We refine this DiD model by incorporating more detailed dynamic timing indicators in such a way that, although without the involvement of *RegIndex*, we are able to tell whether any DiD effect exists

[11] By referring to deregulation, we exclude the law change events, if any, in which more barriers to interstate branching are added.

before the passage of the deregulation laws, or whether the changes in crash risk only occur in the post-deregulation period. In this sense, we can think of Eq. (5) as an alternative framework for the examination on the causal relation between bank competition and crash risk. Specifically, in Eq. (5), if *Pre1* and *Pre2* do not have any significant coefficients, and the significant coefficients are associated with *Year0*, *Post1*, or $Post2^{+}$, then it would suggest that it is the deregulation events that drive the changes in crash risk. The DiD nature of this approach washes out any potential parallel time trends in both treatment group (i.e., firms in the deregulating state) and control group (i.e., firms in other states), and secures balanced examination window around the deregulation event, thus serving as an ideal design for robustness check.

In the first three columns of Table 4, we report the results of the above multi-period dynamic test. The three models with different crash risk measures as the dependent variable share similar patterns around the actual deregulation year: The coefficients on the two pre-period indicator variables, *Pre2* and *Pre1*, are small and statistically insignificant, suggesting that firms' crash risk shows no significant change prior to the adoption of the deregulation laws. By contrast, the three post-period variables *Year0*, *Post1*, and $Post2^{+}$ have negative and generally significant coefficients. They have much larger magnitudes than those in the pre-deregulation period, and exhibit a general decreasing trend (i.e., become more negative) as we move forward from the reform year, especially in the *NCSKEW* and *DUVOL* cases. This evidence suggests that crash risk levels become lower after banking deregulation for firms in the deregulating state, relative to the concurrent crash risk change for firms in states without deregulation events. This DiD result thus clearly confirms that the change in crash risk arises because the states pass the branching deregulation legislations, which further mitigates potential endogeneity problem and also implies that there is no differing pre-existing trend in crash risk between treatment and control firms prior

to interstate branching deregulation. Economically, the result from Eq. (5) is consistent with our baseline result from Eq. (4) because both of them show that enhanced bank competition, as reflected either in reduced *RegIndex* or the passage of deregulation laws, brings in lowered level of crash risk.

Although the IBBEA adoption in different states represents regulatory shocks to bank competition that are largely exogenous to borrowing firms, which is further secured by the accounts of the political economy of the branching deregulation reforms, one potential endogeneity concern may still arise that pertains to the possibility of an omitted trend coinciding with the deregulation. Such an omitted shock could be the true underlying cause of the change in crash risk, but because it is unobservable, its impact is manifested via the (superficial) influence of branching deregulation as documented in the baseline regression. In the second way of robustness check, we devote additional effort to addressing this issue. We draw on our baseline identification strategy that features a staggered adoption process for the banking deregulation policies, and posit that this process is unlikely to be accompanied by the fluctuation of an omitted variable at each and every deregulation event time (or most of the time). To confirm this conjecture, we conduct a placebo test by randomizing the deregulation events in such a way that the actual deregulation trend is filtered out but the unobservable shock, if any, is maintained. Specifically, we randomly assign states into the deregulation states and non-deregulation ones each year according to the empirical distribution of the actual deregulation events across different years. With the distributional pattern of regulatory years unchanged from our baseline specification, this approach largely wipes out the correct identification of branching regulation changes because we interrupt the proper matching of deregulation states and deregulation years. In this situation, the effect from bank branching reforms would disappear. Meanwhile, if there is any impact from unobservable shocks from an omitted

variable that occur at approximately the same time as the actual deregulation events but are not randomized, the impact should still persist and thus drive the result; If no such omitted variable exists, then the result should vanish. In short, by observing whether the significant coefficient on the IBBEA deregulation index remains in a setting with randomly assigned state-year, we can obtain inference about whether our baseline results are subsumed by an omitted variable.

We re-estimate the baseline regression in Eq. (4) using the randomized deregulation index, here we denote by *Pseudo RegIndex*, and report the results in columns 4-6 of Table 4. We find that *Pseudo RegIndex* ceases to influence crash risk measured either by *CRASH*, *NCSKEW*, or *DUVOL*: Its coefficient becomes substantially small (close to zero) and statistically insignificant. The evidence clearly suggests that our baseline results are unlikely to be driven by unobservable concurrent shocks from an omitted variable, and the disappearance of the effect of the deregulation index is mainly due to the disappearance of the proper identification of the deregulation events.

5. The roles of bank monitoring and funding in the bank competition effect on crash risk

Our findings so far show that borrowers' firm-specific stock crash risk is significantly reduced in a more competitive environment of lending banks. This is an end-of-pipe effect. Prior theoretical and empirical works suggest that crash risk is plausibly driven by managerial piling of bad news, and bank competition may influence firm managers via banks' screening & monitor and funding functions embedded in the bank-firm relations. In this section, we seek evidence regarding this mechanism.

We start with the exploration of the general connections between banks and firms. Banks need these connections to exert their influence on firms. If firms have heavy dependence on banks to conduct their business, or more generally, an economy is significantly reliant on financial market, financial service industry, especially banks, should play an important in influencing firm

activities, including managerial behaviors. This consideration motivates us to examine firms' bank dependence as the first cross-sectional test. Specifically, following Rajan and Zingales (1998) and Cetorelli and Strahan (2006), we assess firms' degree of dependence on banks by their demand for external funds estimated by the gap between total capital expenditures and cash flow from operations. Cetorelli and Strahan (2006) justify that an instrument for bank dependence constructed this way is highly correlated with firms' actual use of bank and other intermediary funds. We then partition our sample firms into high- and low-dependence subgroups according to the median value of bank dependence estimates, and re-estimate the baseline model in Eq. (4) in each subgroup. Table 5, Panel A shows that in the subsample of firms with high level of bank dependence, bank competition induced by branching deregulation engenders a much stronger impact on firms' stock crash risk, measured in any of the three ways, than in firms with low level of bank dependence. In fact, among low-dependence firms, the coefficients on *RegIndex* become insignificant and small in all the model specifications involving *CRASH*, *NCSKEW*, and *DUVOL*. This evidence reveals that bank competition's influence on firm crash risk largely depends on how influential the bank system is in the product market. It further suggests that in a market with relatively less (more) developed financial system, both the firms' dependence on banks and banks' influence on firms tend to be weaker (stronger), which naturally diminishes (boosts) the shocks to the product market from any reforms in the banking system.

After establishing the link between bank competition and firm crash risk via overall bank dependence of firms, we move on to look for more direct evidence on the roles of monitoring and funding which are arguably the most commonly accepted determinants of firm-specific stock crashes. In Panel B of Table 5, we focus on firm opaqueness to examine the function of bank screening & monitoring, because the unique advantage of banks in obtaining private information

and supervising debtors' behaviors tends to be more prominent in a firm that is uneasy to understand. If the change in bank competition environment does not work on firm crash risk by changing banks' willingness and ability to screen and monitor borrowers, we would not observe the influence of branching deregulation conditioning on the level of borrowers' opaqueness. In fact, we do observe such a conditioning effect. As shown in Panel B, after partitioning the sample firms by the median level of opaqueness, measured by absolute discretionary accruals, we find that *RegIndex*'s impacts on the three crash risk measures are significantly larger in the high-opaqueness firms than in the low-opaqueness firms: The coefficient magnitude in the former group is more than two times of that in the latter group for the measure *DUVOL*, three times for *NCSKEW*, and ten times for *CRASH*. This evidence is consistent with our conjecture about bank screening and monitoring in the connection between bank competition and firm crash risk.

In Panel C of Table 5, we delve into the funding function of banks in their influence on crash risk by conditioning on firm innovations. The rationale is that, although the literature is divergent on the overall liquidity provision function of bank competition, prior studies (e.g., Amore et al. 2013; Chava et al. 2013; Cornaggia et al. 2015) have generally reached a consensus that bank deregulation is especially beneficial to innovations by making banking funds easier and cheaper for firms' innovative projects. Innovation therefore presents an unambiguous setting for examining our bank funding conjecture. Following the traditional approach in prior literature, we use research and development (R&D) expenditures (scaled by total assets) to reflect the general innovative behaviors in the sample firms, and form subsamples according to the median value. The results show that the influences of *RegIndex* on crash risk measures *CRASH*, *NCSKEW*, and *DUVOL* persist and become much stronger in the high-R&D subsample, and disappear in the low-R&D subsample (where the *RegIndex* coefficient even turns to negative, although insignificant).

The implication is that for firms with more innovative projects, bank competition exhibits a larger constraining influence on their stock crash risk. Combined with findings in prior studies that intensified bank competition also fosters funding provision to innovative firms, our evidence suggests that improved competition in banks affects borrowers' crash risk through a funding-related route, and such a route leads to reduced crash likelihood and magnitude.

To summarize, the many cross-sectional tests in Table 5 send support to the notion that bank competition due to branching deregulation appears to cause changes in firm crash risk via altering the bank functions to monitor and finance borrowing firms, which in turn affect firm crash risk in stock returns. This argument is largely in line with the general logic link between banks, corporate governance, and crash risk.

6. Bank competition and firms' intense divulgence of extremely adverse news and information manipulation

After documenting evidence for the possible behaviors (i.e., monitoring and funding) of banks in the above section, we continue in this section to look into the possible behaviors of firms, in particular, the abrupt extremely adverse reporting and information manipulation, both of which relate to bad news hiding activities: The former is the outcome due to the accumulation of negative news being exceeding the breaking point, while the latter is the channel through which bad news is piled up. Banks' influence on firm crash risk starts from bank behaviors, and logically leads to firm behaviors that end up with changes in realized crash risk triggered by the outbreak of large pieces of adverse information. In this sense, examining firm behavior completes the logic link: The bank monitoring and funding efforts would not change the agency problem-based crash risk without changing the actual managerial concealing of inferior news, and the crash risk would not realize without the avalanche of hidden information.

Guided by this rationale, the first perspective that we take to examine the crash risk-related firm behavior issue revolves around the link between bank competition and the actual releasing events of extremely inferior information that is unknown to (and thus unexpected by) outsiders. Such events are considered to trigger the collapse of stock price in the equity market. To this end, we first estimate annual unexpected earnings as a firm's change in income before extraordinary items from the previous year to the current year, scaled by the lagged market value of equity, and then identify unexpected extremely adverse news divulgence by the years in which (i) the firm's unexpected earnings are in the bottom decile and (ii) its unexpected earnings in the previous year is non-negative. The bottom decile represents the very negative information, while non-negative earnings in prior announcements are to ensure the unexpected nature. We define a dummy variable *SURP_UE* for each firm-year if the above two conditions are satisfied. In a similar manner, we construct another dummy measure *SURP_G* using an alternative source of firm information releasing: the issuing of managerial earnings guidance. Specifically, we identify negative earnings guidance from the announcements that the firm is not expected to meet the prior expectation/target, vis-à-vis other scenarios in which the earnings target is met or exceeded (or the target is not specified). *SURP_G* equals one if a firm issues a negative guidance in the current year but not in the previous year, and zero otherwise. Briefly, both *SURP_UE* and *SURP_G* indicate the incidence of intense adverse information divulging, which have been adopted in existing literature to serve the same purpose in crash risk studies, e.g., Chang et al. (2017).

Using these two indicators as the dependent variable in the baseline Eq. (4), we re-estimate the model and report the results in Table 6. The coefficients on *SURP_UE* and *SURP_G* are positive and statistically significant at the 5% level; They also share similar magnitude of 0.008 and 0.006, respectively, confirming their economic significance because firms in the most open

states are associated with extremely adverse information releasing probability 3.2% lower in earnings announcements and 2.4% lower in managerial earnings guidance, relative to those in the most restrictive states with regard to interstate branching policies. Therefore, more bank competition leads to less releasing of extremely inferior news that can trigger stock price crashes, thus bridging the connection from bank competition to crash risk.

Following with the above analysis, we take the second perspective to see whether bank competition helps in constraining the hoarding of bad news in normal times. If so, banks serve to dissuade managerial misbehavior and encourage fair disclosures, which leads to less abrupt divulgence of accumulated negative message and consequently lower crash risk. In this regard, we focus on the disguising of inferior information as reflected in the manipulation of earnings. Earnings management is a widely adopted way in financial disclosure through which managers use multiple methods to avoid reporting losses, conceal corporate weakness, and withhold other defective information that may cause investors' stock-selling behaviors. Following Cohen and Zarowin (2010) and Zang (2012), we identify earning management behaviors with and without direct cash flow consequences. The cash flow-unrelated earnings management is generally conducted through accruals manipulation; We denoted it by *Accrual_EM*, and estimate it using the cross-sectional Jones (1991) model that captures abnormal accruals. The cash flow-related earnings management is termed real earnings management which alters real activities that deviate from normal business practices (Roychowdhury 2006); We construct two aggregate metrics *Real_EM1* and *Real_EM2* as by Cohen and Zarowin (2010) from potential behaviors that accelerate the timing of sales, report lower cost of goods sold through increased production, and decrease discretionary expenses (the Appendix provides the details).

Using these earning management measures as the dependent variable, we estimate the following model which retains the key IBBEA deregulation index *RegIndex* and adopts control variables identified in prior literature (e.g., Lawrence, Minutti-Meza, and Zhang 2011) that may also affect earnings management:

$$\begin{aligned} Earnings\ Management_{j,t} = {} & \theta_0 + \theta_1 RegIndex_{j,t} + \theta_2 SIZE_{j,t} + \theta_3 ROA_{j,t} + \theta_4 BIG4_{j,t} \\ & + \theta_5 MB_{j,t} + \theta_6 NOA_{j,t-1} + \theta_7 IO_{j,t} + \theta_8 LEV_{j,t} + \theta_9 CR_{j,t} \\ & + Firm\ Fixed\ Effects + Year\ Fixed\ Effects + Residual \quad (6). \end{aligned}$$

In Eq. (6), *Earnings Management* refers to *Accrual_EM*, *Real_EM1*, or *Real_EM2*. The control variables *BIG4*, *NOA*, *IO*, and *CR* refer to, respectively, the indicator for external editor as Big 4 or 5 audit firms, net operating assets, institutional ownership, and current asset ratio. The appendix contains their definition details. Other controls variables are identical to those in the baseline model. The estimation results, as shown in the first three columns of Table 7, suggest a decreased degree of earning management in borrowing firms as the competition among lending banks becomes harsher: The coefficient on *RegIndex* is statistically positive in all model specifications with different earnings management dependent variables, i.e., reduction in *RegIndex* and increase in bank competition degree bring about lower levels of manipulations on either accrued earnings and real earnings behaviors. The evidence suggests that competition in banks makes firms more actively adopt bad news releasing activities. The diminished earning management helps in a better reflection of firm operations in financial disclosures and thus reduces potential bad news hoarding and crash risk.

To have a more comprehensive understanding of information hiding in accounting disclosure, we further examine financial reporting quality, captured by restatement of accounting reports. The idea behind this measurement is that restatement is often triggered by inaccurate

materials in previous financial statements which are plausibly related to managers' intentional concealing of negative information. More directly relevant to our study, a negative restatement often shakes the confidence from investors and causes stock price to decline or even collapse. We replace the earnings management dependent variable in Eq. (6) by a restatement dummy variable *Restatement* which indicates the actual occurrence of restatement events in a given year, and re-estimate the model. Result reported in the last column of Table 7 shows that *RegIndex* has a positive coefficient of 0.008 which is statistically significant at the 5% level (*t*-value = 1.99), suggesting a smaller likelihood of accounting restatement among firms in more bank-competitive states, which reflects improved quality in accounting disclosure and better revealing of negative information. This logically leads to a smaller degree of potential stock crash risk. Overall, findings in Table 7 send consistent message that bank competition fosters improved accounting disclosures that help constrain crash risk.

7. Conclusion

In this paper, we inquire into the possible influences of banks on borrowing firms' stock crash risk. Our inquiry is motivated by banks' unique role in addressing firms' agency problem, mainly through their monitoring and funding functions, in which managerial opportunistic behaviors to conceal unfavorable information may cause the stockpile of bad news and eventually end up in severe stock price crashes. Although the literature on the determinants of crash risk is remarkably vast, the influence from banks is largely neglected. We supplement this literature by examining whether and how banks affect firm crash risk in the context of the interstate branching deregulation process triggered by the IBBEA in the U.S. This institutional setting helps mitigate potential endogeneity problem embedded in the association between banks and firm crash risk, because interstate branching deregulation represents, arguably, the most important U.S. banking

reform in the past century that is nevertheless largely exogenous to firms' product market. The deregulation removes restrictions on out-of-state entry of rivals, and fosters bank competition, which in turn fundamentally changes both the monitoring and funding functions of banks. We therefore focus our exploration on the impact of bank competition on crash risk, zooming in on the change of crash risk along the gradual branching restriction relaxing process in different states.

We document three sets of results that depict a logic link from bank competition to stock crash risk. First, as the baseline result, bank competition reduces firms' crash risk, because firms headquartered in states whose banking markets are more open to out-of-state entry have significantly lower level of price crash risk, as reflected in stock return distributions, than firms in states with more restrictive interstate branching policies; Second, the crash risk-reducing effect of bank competition is more prominent among firms with higher degrees of bank dependence, informational opaqueness, and innovations. Because banks, through their businesses with borrowers, tend to have stronger monitoring function in more opaque firms, and also stronger funding effect in more innovative firms that have been shown to benefit more from bank competition, this evidence is consistent with the conjecture about bank monitoring and funding in banks' influence on borrowers; Third, bank competition reduces incidence of intense adverse information divulgence and mitigates earnings management behaviors in borrowing firms, and improves their reporting quality, all of which could directly lead to less hoarding of inferior news and also less degree of crash risk. Collectively, these results consistently suggest that there exist significant and robust impacts of banks on borrowers' stock crash risk.

Our study, in a broad background, provides insights to the nexus between financial development and economic development. Banking deregulation and bank competition not only help stabilize the financial market, i.e., the risk of banks themselves, as shown in previous studies,

but also contribute to the stabilization of the economic market, i.e., the firms as borrowers, as suggested by our findings. Moreover, we connect competitive shocks to banks with borrowers' information manipulation, which also enriches the way through which banks could affect firm risks, and thus suggest an outlet to examining bank competition, accounting information, and stock market performance.

Appendix: Variable definitions

Bank Competition Measure	
RegIndex	This variable refers to the IBBEA deregulation index for U.S. states and the D.C. developed by Rice and Strahan (2010), representing the number of interstate branching barriers among (i) requiring a minimum age of at least three years on target institutions, (ii) forbidding de novo interstate branching, (iii) applying a deposit cap less than 30%, and (iv) prohibiting individual branch acquisitions. The index is set to zero for states that are most open to out-of-state entry, i.e., without any barriers. The index increases by one when a state adds any of the four barriers just described, and ranges from zero to four. Lower *RegIndex* reflects higher degree of bank competition. Source: Rice and Strahan (2010).
Crash Risk Measures	
CRASH	An indicator variable that equals one if a firm's stock experiences one or more crash weeks during a given year, and zero otherwise. A crash week is a week in which the firm-specific weekly stock return falls 3.2 standard deviations below its mean value for the year. Firm-specific weekly return for each firm in each year is the natural logarithm of one plus the residual from the regression in Eq. (1) in the text. Source: CRSP, COMPUSTAT.
NCSKEW	Negative conditional skewness of the firm-specific weekly returns (as described above) over a year, estimated by the third moment of the distribution of firm-specific returns scaled by its standard deviation raised to the third power, and then multiplied by -1, as in Eq. (2) in the text. Source: CRSP, COMPUSTAT.
DUVOL	Down-to-up volatilities estimated as the logarithm of the ratio of the standard deviation on the down weeks to the standard deviation on the up weeks, as shown in Eq. (3) in the text. Down weeks refer to those with firm-specific returns (as described above) below the mean of the year, and up weeks have firm-specific returns above the annual mean. Source: CRSP, COMPUSTAT.
Baseline Control Variables	
ROA	Income before extraordinary items divided by total assets. Source: COMPUSTAT.
SIZE	The natural logarithm of the market value of equity. Source: COMPUSTAT.
LEV	Total long-term debt scaled by total assets. Source: COMPUSTAT.
MB	Ratio of the market value of equity to the book value of equity. Source: COMPUSTAT.
DTRUN	The current year average monthly share turnover minus the previous year average monthly share turnover, where monthly share turnover is calculated as the monthly trading volume divided by the total number of shares outstanding during the month. Source: COMPUSTAT.
SD_RET	The standard deviation of firm-specific weekly returns over the year. Source: COMPUSTAT.
MEAN_RET	The mean of firm-specific weekly returns over the year, multiplied by 100. Source: COMPUSTAT.
Sample Partitioning Variables in the Tests of Bank Monitoring and Funding Roles	
Bank Dependence	A measure for firms' dependence on banks from Rajan and Zingales (1998) and Cetorelli and Strahan (2006), estimated as total capital expenditure minus operating cash flow, scaled by total assets, which has been shown to be highly correlated with firms' actual use of bank and other intermediary funds. Source: COMPUSTAT.
Firm Opaqueness	Absolute discretionary accruals estimated using a cross-sectional modified-Jones model. Source: COMPUSTAT.
Firm Innovation	R&D expenses scaled by total assets. Source: COMPUSTAT.
Variables in the Tests of Intense Adverse Information Divulging, Earnings Manipulation, and Reporting Quality	
SURP_UE	An indicator variable that equals one if the unexpected earnings of the firm are in the bottom decile in the current year and its unexpected earnings are non-negative in the previous year, and zero otherwise. Unexpected earnings refer to Earnings Per Share (Basic) Excluding Extraordinary Items in the current year minus that in the previous year. Source: COMPUSTAT.
SURP_G	An indicator variable that equals one if the firm is expected to miss the latest management earnings forecast in current year but not in the previous year, and zero otherwise. Source: COMPUSTAT.
Accrual_EM	Abnormal accruals estimated using a cross-sectional modified-Jones model. Source: COMPUSTAT.

Real_EM1	An measure of real earnings management calculated by multiplying abnormal cash flows from operations and abnormal discretionary expenses by negative one and then aggregating them. Source: COMPUSTAT.
Real_EM2	An measure of real earnings management calculated by multiplying abnormal discretionary expenses and negative one and adding it to abnormal production costs. Source: COMPUSTAT.
Restatement	An indicator variable that equals one for a firm-year with restatement, and zero otherwise. Source: COMPUSTAT.
BIG4	An indicator variable that equals one if a Big 5 or 4 audit firm is the external auditor for a firm-year, and zero otherwise. Source: COMPUSTAT.
NOA	Net operating assets, calculated as the sum of shareholders' equity less cash and marketable securities plus total debt, scaled by total assets. Source: COMPUSTAT.
IO	Institutional ownership. Source: COMPUSTAT.
CR	Current assets scaled by total assets. Source: COMPUSTAT.

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Table 1. Sample distribution by year

The sample includes U.S. non-financial public companies during 1996-2016 that are headquartered in the 50 states and the D.C. There are totally 57,062 firm-year observations. This table reports sample distribution by year.

Year	Freq.	Pct.	Cum.
1996	2,279	3.99	3.99
1997	3,699	6.48	10.48
1998	3,829	6.71	17.19
1999	3,748	6.57	23.75
2000	3,274	5.74	29.49
2001	3,121	5.47	34.96
2002	2,989	5.24	40.20
2003	3,039	5.33	45.53
2004	2,931	5.14	50.66
2005	2,730	4.78	55.45
2006	2,585	4.53	59.98
2007	2,560	4.49	64.46
2008	2,338	4.10	68.56
2009	2,450	4.29	72.85
2010	2,343	4.11	76.96
2011	2,220	3.89	80.85
2012	2,176	3.81	84.66
2013	2,146	3.76	88.42
2014	2,197	3.85	92.28
2015	2,183	3.83	96.10
2016	2,225	3.90	100
Total	57,062	100	

Table 2. Summary statistics of main testing variables

This table reports summary statistics of variables in the baseline model. The statistics are computed from all firm-years in the full sample. Details about the variable definitions are provided in the Appendix.

	N	Mean	SD	P25	P50	P75
CRASH	57,062	0.170	0.375	0.000	0.000	0.000
NCSKEW	57,062	0.031	0.850	-0.448	-0.004	0.452
DUVOL	57,062	-0.046	0.379	-0.300	-0.056	0.192
RegIndex	57,062	2.230	1.374	1.000	3.000	3.000
ROA	57,062	-0.021	0.206	-0.025	0.033	0.073
SIZE	57,062	5.923	2.074	4.402	5.888	7.330
LEV	57,062	0.180	0.194	0.002	0.130	0.294
MB	57,062	3.004	4.216	1.226	2.027	3.530
DTURN	57,062	0.022	0.954	-0.266	0.004	0.281
SD_RET	57,062	0.062	0.034	0.036	0.053	0.079
MEAN_RET	57,062	-0.245	0.294	-0.303	-0.140	-0.064

Table 3. Baseline results

This table reports estimation results for the baseline model of Eq. (4). The dependent variables *CRASH*, *NCSKEW*, and *DUVOL* are proxies for stock price crash risk. The key independent variable is the IBBEA deregulation index *RegIndex* whose lower values indicate higher levels of bank competition. Firm and trading characteristic variables are controlled as in Eq. (4). Details about the variable definitions are provided in the Appendix. The regression coefficients on independent variables are reported, followed by the robust *t*-statistics (in the parentheses) based on standard errors adjusted for heteroskedasticity. For brevity, the coefficients on the firm and year dummies are not reported. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)
	$CRASH_t$	$NCSKEW_t$	$DUVOL_t$
RegIndex$_t$	**0.006****	**0.017****	**0.007****
	(2.14)	**(2.33)**	**(2.26)**
ROA_t	-0.099***	-0.312***	-0.124***
	(-7.70)	(-10.59)	(-9.55)
$SIZE_{t-1}$	0.055***	0.223***	0.107***
	(19.34)	(33.50)	(36.28)
LEV_{t-1}	0.033**	0.058	0.017
	(2.07)	(1.50)	(0.99)
MB_{t-1}	0.000	0.003***	0.001**
	(0.76)	(2.84)	(2.42)
$DTURN_{t-1}$	0.007***	0.010**	0.005**
	(3.60)	(2.32)	(2.49)
SD_RET_{t-1}	-0.698***	0.267	-0.118
	(-2.96)	(0.49)	(-0.49)
$MEAN\_RET_{t-1}$	-0.009	0.062	0.023
	(-0.39)	(1.13)	(0.95)
Intercept	-0.161***	-1.339***	-0.695***
	(-7.16)	(-25.09)	(-29.39)
Firm Fixed Effects	Included	Included	Included
Year Fixed Effects	Included	Included	Included
No. of Observations	57,062	57,062	57,062
R-Squared	0.020	0.044	0.053

Table 4. Robustness tests for the baseline model

The dependent variables *CRASH*, *NCSKEW*, and *DUVOL* are proxies for stock price crash risk. In columns 1-3, the key independent variables are the indicators for the seven years surrounding a state's adoption event of the IBBEA. *Year0* indicates the event year, *Pre1* and *Pre2* indicate one and two years before the deregulation, respectively, and *Post1* and *Post2*$^{+}$ indicate one and two or more years after the deregulation, respectively. In columns 4-6, the key independent variable *Pseudo RegIndex* refers to the randomized deregulation index. Firm and trading characteristic variables are controlled as in Eq. (4). Details about the variable definitions are provided in the Appendix. The regression coefficients on independent variables are reported, followed by the robust *t*-statistics (in the parentheses) based on standard errors adjusted for heteroskedasticity. For brevity, the coefficients on the firm and year dummies are not reported. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dynamic DiD Test			Random Effect Test		
	(1)	(2)	(3)	(4)	(5)	(6)
	$CRASH_t$	$NCSKEW_t$	$DUVOL_t$	$CRASH_t$	$NCSKEW_t$	$DUVOL_t$
Pre2	-0.017	-0.028	0.004			
	(-0.79)	(-0.61)	(0.20)			
Pre1	-0.023	-0.055	-0.017			
	(-1.19)	(-1.34)	(-0.90)			
Year0	**-0.039****	**-0.091****	-0.020			
	(-1.96)	**(-2.07)**	(-1.02)			
Post1	-0.030	**-0.105****	-0.030			
	(-1.43)	**(-2.25)**	(-1.43)			
Post2^{+}	-0.033	**-0.160*****	**-0.051****			
	(-1.41)	**(-2.99)**	**(-2.17)**			
Pseudo RegIndex$_t$				-0.000	0.001	0.001
				(-0.35)	(0.40)	(0.60)
ROA_t	-0.080***	-0.180***	-0.081***	-0.099***	-0.311***	-0.124***
	(-3.04)	(-3.06)	(-3.04)	(-7.67)	(-10.57)	(-9.53)
$SIZE_{t-1}$	0.072***	0.294***	0.146***	0.054***	0.223***	0.107***
	(9.82)	(17.88)	(20.12)	(19.25)	(33.36)	(36.15)
LEV_{t-1}	-0.004	-0.036	-0.021	0.028*	0.053	0.017
	(-0.11)	(-0.43)	(-0.58)	(1.89)	(1.54)	(1.16)
MB_{t-1}	0.001	0.0030	0.000	0.000	0.003***	0.001**
	(1.16)	(1.25)	(0.39)	(0.77)	(2.88)	(2.44)
$DTURN_{t-1}$	0.011***	0.023**	0.009**	0.007***	0.010**	0.005**
	(2.79)	(2.47)	(2.09)	(3.60)	(2.37)	(2.50)
SD_RET_{t-1}	-1.553***	-1.501**	-0.586*	-0.906***	-0.334	-0.415***
	(-5.30)	(-2.04)	(-1.80)	(-6.40)	(-1.18)	(-3.24)
$MEAN\_RET_{t-1}$	-0.045***	-0.0540	-0.026	-0.032***	-0.001	-0.010
	(-2.76)	(-1.10)	(-1.19)	(-3.38)	(-0.06)	(-1.40)
Intercept	-0.148***	-1.473***	-0.826***	-0.130***	-1.262***	-0.662***
	(-3.17)	(-14.04)	(-17.47)	(-6.70)	(-27.68)	(-32.50)
Firm Fixed Effects	Included	Included	Included	Included	Included	Included
Year Fixed Effects	Included	Included	Included	Included	Included	Included
No. of Observations	15,019	15,019	15,019	57,062	57,062	57,062
R-Squared	0.027	0.061	0.070	0.020	0.044	0.053

Table 5. The roles of bank monitoring and funding

The baseline model of Eq. (4) is estimated in subsamples partitioned according to the levels of firms' bank dependence (in Panel A), firm opaqueness (in Panel B), and firm innovation (in Panel C). The dependent variables *CRASH*, *NCSKEW*, and *DUVOL* are proxies for stock price crash risk. The key independent variable is the IBBEA deregulation index *RegIndex*. Firm and trading characteristic variables are controlled as in Eq. (4). Details about the variable definitions are provided in the Appendix. The regression coefficients on independent variables are reported, followed by the robust *t*-statistics (in the parentheses) based on standard errors adjusted for heteroskedasticity. For brevity, the coefficients on the firm and year dummies are not reported. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Bank dependence

	Low Bank Dependence			High Bank Dependence		
	(1)	(2)	(3)	(4)	(5)	(6)
	$CRASH_t$	$NCSKEW_t$	$DUVOL_t$	$CRASH_t$	$NCSKEW_t$	$DUVOL_t$
***RegIndex**$_t$*	0.004	0.002	0.001	**0.009****	**0.036*****	**0.016*****
	(0.95)	(0.16)	(0.14)	**(2.15)**	**(3.48)**	**(3.48)**
ROA_t	-0.168***	-0.483***	-0.203***	-0.083***	-0.243***	-0.094***
	(-4.99)	(-6.31)	(-6.08)	(-5.35)	(-6.84)	(-6.00)
$SIZE_{t-1}$	0.065***	0.239***	0.116***	0.052***	0.228***	0.109***
	(14.08)	(23.70)	(25.97)	(13.30)	(23.94)	(25.83)
LEV_{t-1}	0.018	0.071	0.023	0.047**	0.061	0.015
	(0.70)	(1.17)	(0.88)	(2.07)	(1.11)	(0.64)
MB_{t-1}	0.001	0.006***	0.002***	0.000	0.002	0.001
	(1.33)	(3.13)	(2.91)	(0.05)	(1.17)	(0.83)
$DTURN_{t-1}$	0.007**	0.011*	0.004	0.008***	0.008	0.004*
	(2.15)	(1.65)	(1.51)	(3.24)	(1.40)	(1.69)
SD_RET_{t-1}	-0.951**	0.492	0.179	-0.912***	-1.596**	-1.040***
	(-2.44)	(0.56)	(0.47)	(-2.72)	(-2.02)	(-3.02)
$MEAN\_RET_{t-1}$	-0.051	0.032	0.033	-0.012	-0.077	-0.054
	(-1.22)	(0.33)	(0.79)	(-0.39)	(-1.03)	(-1.63)
Intercept	-0.202***	-1.426***	-0.755***	-0.148***	-1.318***	-0.678***
	(-5.56)	(-17.86)	(-21.12)	(-4.77)	(-17.48)	(-20.24)
Firm Fixed Effects	Included	Included	Included	Included	Included	Included
Year Fixed Effects	Included	Included	Included	Included	Included	Included
No. of Observations	27,879	27,879	27,879	29,183	29,183	29,183
R-Squared	0.022	0.040	0.048	0.022	0.054	0.065

Panel B: Firm opaqueness

	Low Firm Opaqueness			High Firm Opaqueness		
	(1)	(2)	(3)	(4)	(5)	(6)
	$CRASH_t$	$NCSKEW_t$	$DUVOL_t$	$CRASH_t$	$NCSKEW_t$	$DUVOL_t$
RegIndex$_t$	0.001	0.009	0.005	**0.010****	**0.027****	**0.011****
	(0.22)	(0.88)	(1.01)	**(2.16)**	**(2.44)**	**(2.19)**
ROA_t	-0.182***	-0.536***	-0.220***	-0.085***	-0.265***	-0.100***
	(-5.68)	(-7.15)	(-6.74)	(-5.51)	(-7.56)	(-6.48)
$SIZE_{t-1}$	0.052***	0.217***	0.106***	0.059***	0.231***	0.109***
	(11.48)	(21.04)	(23.63)	(15.35)	(25.04)	(26.85)
LEV_{t-1}	0.051**	0.074	0.028	0.015	0.014	-0.008
	(1.96)	(1.25)	(1.09)	(0.66)	(0.26)	(-0.34)
MB_{t-1}	0.001	0.007***	0.003***	-0.000	0.001	0.000
	(1.51)	(3.65)	(3.58)	(-0.53)	(0.79)	(0.26)
$DTURN_{t-1}$	0.010***	0.014**	0.006**	0.004	0.005	0.003
	(3.19)	(2.07)	(2.05)	(1.47)	(0.74)	(1.00)
SD_RET_{t-1}	-0.799**	1.668*	0.445	-0.921***	-1.422*	-0.725**
	(-2.13)	(1.91)	(1.16)	(-2.66)	(-1.80)	(-2.11)
$MEAN\_RET_{t-1}$	-0.0180	0.220**	0.090**	-0.0310	-0.118	-0.044
	(-0.46)	(2.32)	(2.16)	(-0.93)	(-1.53)	(-1.33)
Intercept	-0.143***	-1.370***	-0.717***	-0.171***	-1.336***	-0.694***
	(-4.01)	(-16.80)	(-20.28)	(-5.25)	(-17.35)	(-20.21)
Firm Fixed Effects	Included	Included	Included	Included	Included	Included
Year Fixed Effects	Included	Included	Included	Included	Included	Included
No. of Observations	28,115	28,115	28,115	28,947	28,947	28,947
R-Squared	0.017	0.038	0.046	0.025	0.051	0.061

Panel C: Firm innovation

	Low Firm Innovation			High Firm Innovation		
	(1)	(2)	(3)	(4)	(5)	(6)
	$CRASH_t$	$NCSKEW_t$	$DUVOL_t$	$CRASH_t$	$NCSKEW_t$	$DUVOL_t$
RegIndex$_t$	-0.000	0.009	0.003	**0.011*****	**0.023****	**0.011****
	(-0.01)	(0.94)	(0.68)	**(2.65)**	**(2.17)**	**(2.19)**
ROA_t	-0.176***	-0.524***	-0.208***	-0.074***	-0.238***	-0.096***
	(-6.98)	(-8.97)	(-8.07)	(-4.85)	(-6.86)	(-6.30)
$SIZE_{t-1}$	0.055***	0.233***	0.112***	0.057***	0.222***	0.106***
	(12.92)	(22.71)	(24.74)	(14.64)	(24.52)	(26.51)
LEV_{t-1}	0.067***	0.130**	0.049**	-0.012	-0.024	-0.023
	(2.81)	(2.37)	(1.99)	(-0.53)	(-0.44)	(-0.98)
MB_{t-1}	0.000	0.003	0.001	0.000	0.004**	0.001**
	(0.49)	(1.55)	(1.27)	(0.51)	(2.43)	(2.22)
$DTURN_{t-1}$	0.008***	0.016**	0.007**	0.005**	0.004	0.002
	(2.63)	(2.47)	(2.47)	(2.22)	(0.73)	(0.88)
SD_RET_{t-1}	-1.103***	-1.268	-0.823**	-0.297	1.298*	0.446
	(-3.26)	(-1.57)	(-2.34)	(-0.88)	(1.66)	(1.29)
$MEAN\_RET_{t-1}$	-0.055	-0.119	-0.061	0.028	0.172**	0.078**
	(-1.64)	(-1.39)	(-1.64)	(0.89)	(2.28)	(2.35)
Intercept	-0.148***	-1.344***	-0.694***	-0.184***	-1.360***	-0.714***
	(-4.54)	(-17.56)	(-20.37)	(-5.67)	(-17.45)	(-20.69)
Firm Fixed Effects	Included	Included	Included	Included	Included	Included
Year Fixed Effects	Included	Included	Included	Included	Included	Included
No. of Observations	28,758	28,758	28,758	28,304	28,304	28,304
R-Squared	0.020	0.046	0.055	0.022	0.045	0.054

Table 6. Bank competition and intense adverse information divulging

The dependent variables *SURP_UE* and *SURP_G* are indicators for the incidence of abrupt releasing of extremely negative information via earnings announcements and managerial earnings guidance, respectively. The key independent variable is the IBBEA deregulation index *RegIndex*. Firm and trading characteristic variables are controlled as in Eq. (4). Details about the variable definitions are provided in the Appendix. The regression coefficients on independent variables are reported, followed by the robust *t*-statistics (in the parentheses) based on standard errors adjusted for heteroskedasticity. For brevity, the coefficients on the firm and year dummies are not reported. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
	$SURP\_UE_t$	$SURP\_G_t$
***RegIndex**$_t$*	**0.008****	**0.006****
	(2.01)	**(2.50)**
ROA_t	0.0280	-0.338***
	(1.19)	(-23.93)
$SIZE_{t-1}$	0.073***	0.032***
	(16.53)	(15.53)
LEV_{t-1}	0.00200	-0.078***
	(0.10)	(-6.78)
MB_{t-1}	0.00100	-0.001**
	(1.50)	(-2.56)
$DTURN_{t-1}$	0.006**	0.009***
	(1.98)	(5.97)
SD_RET_{t-1}	-0.849**	0.0340
	(-2.17)	(0.20)
$MEAN\_RET_{t-1}$	-0.114**	0.0170
	(-2.57)	(0.95)
Intercept	-0.494***	-0.136***
	(-12.43)	(-7.69)
Firm Fixed Effects	Included	Included
Year Fixed Effects	Included	Included
No. of Observations	30,324	57,062
R-Squared	0.145	0.182

Table 7. Bank competition and earnings management and reporting quality

The dependent variable *Accrual_EM* refers to accrual-based earnings management, *Real_EM1* and *Real_EM2* are two real earnings management measures, and *Restatement* indicates the occurrence of accounting restatement. The key independent variable is the IBBEA deregulation index *RegIndex*. Firm characteristic variables are controlled as in Eq. (6). Details about the variable definitions are provided in the Appendix. The regression coefficients on independent variables are reported, followed by the robust *t*-statistics (in the parentheses) based on standard errors adjusted for heteroskedasticity. For brevity, the coefficients on the firm and year dummies are not reported. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	$Accrual\_EM_t$	$Real\_EM1_t$	$Real\_EM2_t$	$Restatement_t$
***RegIndex**$_t$*	**0.002****	**0.011****	**0.008****	**0.008****
	(2.22)	**(2.01)**	**(2.15)**	**(1.99)**
$SIZE_t$	0.006***	-0.053***	-0.044***	0.008***
	(6.90)	(-10.55)	(-12.43)	(3.25)
ROA_t	0.034***	0.270***	0.077***	-0.004
	(8.79)	(9.59)	(3.76)	(-0.49)
$BIG4_t$	-0.006**	0.040***	0.032***	-0.012
	(-2.54)	(3.22)	(3.84)	(-1.40)
MB_t	0.000*	-0.001	-0.001	0.000
	(1.65)	(-1.58)	(-1.52)	(1.13)
NOA_{t-1}	-0.024***	0.088***	0.042***	0.005
	(-16.24)	(11.42)	(7.89)	(0.93)
IO_t	0.009**	0.055***	0.031***	-0.005
	(2.56)	(3.53)	(2.87)	(-0.41)
LEV_t	-0.015***	-0.157***	-0.129***	0.004
	(-4.90)	(-7.50)	(-8.20)	(0.56)
CR_t	0.000	0.008***	0.002	-0.001
	(-0.89)	(3.47)	(1.17)	(-0.97)
Intercept	-0.011*	0.224***	0.196***	-0.004
	(-1.85)	(7.12)	(8.92)	(-0.26)
Firm Fixed Effects	Included	Included	Included	Included
Year Fixed Effects	Included	Included	Included	Included
No. of Observations	73,710	73,710	73,710	42,502
R-Squared	0.018	0.045	0.031	0.058